U.S. Agriculture and the Emerging Bioeconomy

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I am pleased to have been invited to discuss the emerging bioeconomy and its implications for U.S. agriculture. . . A man walks into a church…no, wait a minute, we are in St. Louis, let me start over. A man walks into a bar . . . and says to the bartender, "So what's an economist anyway?" That's easy says the bartender, "It's someone who throws cold water on the bad ideas of other people.". . . I know what you are thinking, I should have said ". . . the good ideas," right? . . . Well as dismal as my science may be perceived at times, I am anything but dismal about the possibility that something truly transformational may take place in agriculture due to demand for renewable energy.

But I do have some concerns about the consequences of the rapid growth in demand. (SLIDE 1) So, I will start by reviewing the market potential for renewable fuels and the potential impact on agriculture, then look at several issues that must be addressed to facilitate expanded supply and demand, and finally say a few words about policy. My main point is this: the opportunities are great, but there are some issues we must deal with or risk not realizing the profound opportunities for agriculture.

With the energy crisis of the 1970s, a public consensus emerged that new energy sources from agriculture could expand U.S. energy supplies and help lessen our use of imported oil. Renewable energy is hardly a new idea. Wood has provided most of the biomass energy over the years, but wind and biofuels have been growing rapidly over the

past decade. (SLIDE 2) The first figure illustrates the growth in ethanol production over the past decade compared with gasoline. In 1996, ethanol met 0.8 percent of gasoline demand. By 2000, its share was 1.2 percent. By 2005, it was nearly 3 percent, and forecasts for 2006 place it at 3.5 percent—a 6-fold increase over the decade.

I think everyone would agree that today's market share is low. (SLIDE 3) But by another measure—marginal analysis—it is high. Over the past decade, gasoline demand increased by 20 billion gallons while ethanol production rose by 4 billion gallons. That 4-billion-gallon increase met 20 percent of the increase in gasoline use over the decade.

(SLIDE 4) Biofuels' role is even more dramatic if we look at the most recent years. Since 2000, ethanol has met over 30 percent of the increase in gasoline demand. So I ask you to imagine, if 30 percent of the marginal gasoline demand over the past 5 years did not come from biofuels, what might crude oil refining margins and gasoline imports look like? Augmenting fuel supplies with biofuels is sure superior to what oil analyst Jay Leno said was the oil industry's plan to increase crude oil production—and that was to make smaller barrels!

(SLIDE 5) Because I like long time series, the next slide shows the total U.S. energy consumption in Btus since the year 1645. I was going to comment on the quality of EIA surveys in 1645, then I found out the data are from USDA's Forest Service, so I am convinced they must be accurate. Several conclusions jump out. First, energy use really took off since World War II. That of course coincides with the greatest period of economic growth in our country's history. EIA estimates the U.S. will consume slightly over 100 quadrillion Btus of energy this year, 8 times the level at the beginning of the last

century. A second observation is that while total energy demand has increased sharply, renewable energy use has remain fairly flat, increasing from 2 quads in 1905 to about 6.7 quads in 2006.

A third observation is that U.S. energy use is projected to increase by over 30 percent by 2030: from 100 to 134 quads. This means renewable energy production must also increase by 30 percent over the period simply to maintain its current share of total energy use. (SLIDE 6) And, it must grow substantially more than 30 percent to significantly reduce fossil-fuel dependence. It is very clear that the expected growth in total U.S. energy demand represents an enormous potential for renewable fuels, with crucial implications for agriculture, forestry, and rural America.

So, let me offer a few thoughts about ethanol and agriculture. (SLIDE 7) This graph shows the share of annual U.S. corn production used for ethanol. A decade ago, less than 5 percent of corn production was used. In 2000, it was 6 percent, but last year it was up to 14 percent. For the 2006 crop, we expect nearly 20 percent – over 2 billion bushels – will be converted into ethanol, nearly equal to the amount of corn exported. Despite ethanol's small share of gasoline demand, it already claims a large share of corn production.

For biodiesel, the supplies of vegetable oils and animal fats are also small compared to the size of the diesel fuel market. For the 2005 soybean crop, biodiesel production accounted for 5 percent of soybean oil use. But only one year later, 2006, we expect biodiesel to consume 13 percent of total soybean oil use

For people in production agriculture, these soaring new sources of crop demand are pretty heady stuff. They are creating ethanol euphoria, similar to the export euphoria of the 1970s when the former Soviet Union first started importing our grain. The increase in corn production used for ethanol highlights two key issues: First, as more corn moves to more ethanol plants, corn prices will rise, corn acreage is likely to rise, and there will be ripple effects on agricultural commodity markets broadly. Second, and a theme of this conference, because corn production is small compared with gasoline demand, other sources of renewable and alternative energy must be developed if the U.S. is to make a dent in oil imports.

This year, ethanol production is expected to be about 1 billion gallons above last year. Using the long-term trend yield for corn this year of 149 bushels per harvested acre, a 1-billion-gallon increase in ethanol production would use the corn produced on nearly 2.5 million acres. Now, I am going to do arithmetic, and as an economist might say, make a "ceteris paribus" statement. Everything held constant, including current corn yields per acre, to increase ethanol production by 5 billion gallons (and that would double this year's production level), we would need to use the corn production from over 10 million acres.

In such a world, corn prices would rise sharply to draw into production the needed corn acres. And, there is a concern that increased global food demand, in places such as China, will increase corn export demand as well in the future. Thoughts like these are putting a gleam in some corn producers' eyes but a frown on some corn users faces. Of course, the real world is not an economist's "ceteris paribus" world. Things like yields,

don't stay constant, they change. Facilitating the changes that allow agricultural markets to avoid acreage pressure, and adjust easily and smoothly to meet consumer demand, is a critical challenge, if renewable energy is to advance toward the goals that have been voiced by so many at this conference.

Let me turn to what I think are the keys to facilitating that change. The first is a*gricultural research.* Research was the founding role for USDA and has been fundamental for nearly 150 years. Research, whether performed and supported by USDA, or by others, has enhanced agricultural productivity, increased agricultural output, and expanded agricultural exports, all while less cropland is being farmed.

Productivity measures the ability to achieve more output from a given bundle of inputs. Technology advances that have raised productivity have been a critical source of income growth, wealth creation, and international competitiveness. (SLIDE 8) This graph shows agricultural output over time. (SLIDE 9) If we overlay productivity, we see all the growth in U.S. agricultural output over the last 50 years is explained by growth in productivity. Growth in inputs used, such as land, has been quite modest.

How does research translate to the potential for ethanol production? (SLIDE 10) When corn yields are added to the figure, you see the strong correlation between productivity and corn yields over time. Since 1948, corn yields have increased four-fold, from 40 bushels per acre to 160 bushels in 2004 due to fertilizers, better management, technology, and new varieties. Accelerating agriculture's already exceptional record of increasing productivity is a key challenge for biofuels success.

It does appear corn yields in the past couple of years have moved above the long-term trend and may do so in coming years as well, helping to meet biofuel demand and reduce pressure on corn prices and acreage. Genetically engineered varieties have gone from 25 percent of corn acres in 2000 to 61 percent this year. Over the past few years, new generation root worm resistant corn has been introduced and is showing strong yield increases in many areas. Over the next couple of years, drought resistant varieties are expected to become commercially available. (SLIDE 11) We shall see where yields go in the future. But each 5 bushel increase in yield above the current trend level would be the equivalent of adding around 2.5 million acres to corn plantings, enough to produce that additional one billion gallons of ethanol each year that I spoke about earlier.

A related challenge is addressing environmental consequences, should substantially more corn acres come into production. Marginal land shifting in and out of cultivation tends to be more vulnerable to erosion from rain and wind and has greater nutrient runoff and leaching potential than more productive cropland. Corn is also a big user of nutrients which can adversely affect water quality. To meet biofuel demand, some corn acreage could return to production from land in the long-term Conservation Reserve Program, but it may be environmentally sensitive and would need to be properly farmed.

Another issue is that growers planting Bt corn are obligated to plant a refuge in nonbiotech varieties to help prevent corn insects from developing resistance to Bt technology. Chemicals applied to refugia may also be a water quality threat. Moreover, to achieve biomass yields contemplated for cost-efficient cellulosic ethanol on marginal

lands will require new varieties and likely much fertilizer, also posing runoff problems. I believe these issues can be managed. The 2002 Farm Bill greatly increased financial support for conservation programs, farm management is steadily improving, and a new farm bill in 2007 could do more in this area.

A second key challenge is in the area of *alternative feedstocks*. Even with higher corn yields, corn ethanol alone cannot greatly reduce U.S. crude oil imports. Nearly 60 percent of U.S. crude oil use is imported. This year's expected ethanol production on an energy content basis is equivalent to only 1.5 percent of U.S. crude oil imports.

Cellulosic ethanol now appears to be the best biofuel alternative for reducing crude oil imports, but making it commercially feasible on a wide scale is a formidable challenge. Information at this conference suggests plants are close to being economically viable. But this is the "show me" state, and at this moment, they have not been built on a commercial scale. (SLIDE 12) The capital requirement per gallon is much higher than corn ethanol. Ethanol yield is lower per ton of feedstock and conversion is complex, requiring enzymes that cost substantially more than for corn ethanol. Harvesting, bailing, storing, and transportation of biomass are expensive. All these barriers are recognized, and greater government and private sector research and investment capital are now being directed at overcoming them.

For example, you have just heard about DOE's ambitious research plan for cellulosic ethanol. In the past, USDA's research priorities were food and fiber. Today, they are food, fiber and energy. We are working with DOE, and we shifting priorities toward cellulosic ethanol. We have a research program with 4 pillars:

1—cellulosic feedstock design, which aims to develop high yielding biomass feedstock suitable to as many ecoregions in the U.S. as possible,

2—cellulosic feedstock production, which focuses on production management techniques, including ways to help provide biorefineries with year-round supplies,

3—cellulosic feedstock logistics, which addresses the need for sustainable and efficient harvesting, handling, storage and delivery of biomass, and

4—cellulosic feedstock conversion.

USDA's Forest Service, manager of 192 million acres, also conducts research and works with partners to address related issues of forest biomass management and use.

Another way to reduce U.S. fossil energy use is to expand the use agricultural feedstocks to produce non-traditional products, such as chemicals, plastics, hydraulic fluids, and pharmaceuticals. USDA is attempting to stimulate the use of biobased products through the Biopreferred Program created by the 2002 Farm Bill. Under the program, all Federal agencies must purchase qualified biobased products if the products are available, meet performance standards, are not excessive in cost, and have been designated by Secretary Johanns to be economically and technically feasible. With a proposed rule issued yesterday, 36 categories covering over 2,400 biobased products have been designated or proposed for Federal procurement preference.

I will end with a brief thought about the challenge renewable energy faces in the public policy arena. (SLIDE 13) In a competitive market, market prices usually provide the best stimulus to meet consumer demand in the most cost-effective way. Oil selling

for $60 per barrel is a powerful incentive to develop both fossil and renewable energy and conserve energy. Generally, taxes, subsidies and regulation reduce market efficiency if they are applied in competitive markets with no externalities. And, bioenery has a number of market interventions at both the Federal and State levels.

We usually argue that direct market intervention is justified, because environmental and energy security benefits of biofuels are not reflected in their market prices. Thus, market prices for biofuels may provide an underincentive to produce and consume biofuels when both market and nonmarket costs and benefits are considered. However, one challenge is the difficulty of placing a value on the external benefits of biofuels to appropriately set subsidy levels. To make this argument well in the future, more work is needed in this area. Another challenge facing the biofuels industry is to explain whether market intervention subsidies that encourage production are complementary or redundant with regulation, such as the Renewable Fuel Standard which mandates consumption.

Increasingly, the existing market intervention incentives are being augmented with more grants for feasibility and development work, research expenditures to overcome cost barriers, and commercialization programs, such as loan guarantees, to stimulate private investment. These approaches, positive and justifiable, address activities the private sector may underfund for risk reasons, and put more emphasis on market signals to allocate resources efficiently.

(SLIDE 14) In conclusion, America's undeniable need for energy today and tomorrow offers a great economic opportunity for biofuels. This opportunity makes me a biofuels cheerleader. At the same time, raising market share to the point that U.S. crude oil imports are materially reduced poses many issues which may not be overcome if our cheerleading obscures the need for careful analysis and thoughtful action. We need to think broadly about the implications for farm and fuel markets, the environment, food, feed and fuel consumers, and taxpayers. We need to attack the challenges on multiple fronts with market-based policies and smart public-private efforts and partnerships. We also need to look beyond our borders and interact on areas of mutual interest with other countries where biofuel production and use are emerging. The potential costs to our society of failing to develop new energy sources, and the potential benefits to agriculture and rural America of developing them, leave only one conclusion: we must work vigorously to make the 21 century the renewable energy century. Thank you.